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## The Role of High-Tech Exports and of Foreign Direct Investments (FDI) on Economic Growth

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**Abstract:**

*Earlier studies of economic growth models are generally characterized by macroeconomics variable using the behavior of capital, population, and exports. In fact, every country has its respective export composition according to human capabilities and technologies.*

*This study involves FDI, high-tech and non high-tech exports, and GDP using 50 countries in the period 1992-2014. The results using random effect model shows that non-high-tech exports affect positively on GDP growth on the entire sample.*

*Given this point, high-tech export industries in both groups (the non-high-tech and the high-tech intensive exports countries) have better productivity compared to domestic industry.*

**Keywords:** Technology, Economic Growth, Foreign Direct Investment, International Trade, Econometrics

**JEL Code :** O14, F43, F21, F16, C32

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## 1. Introduction

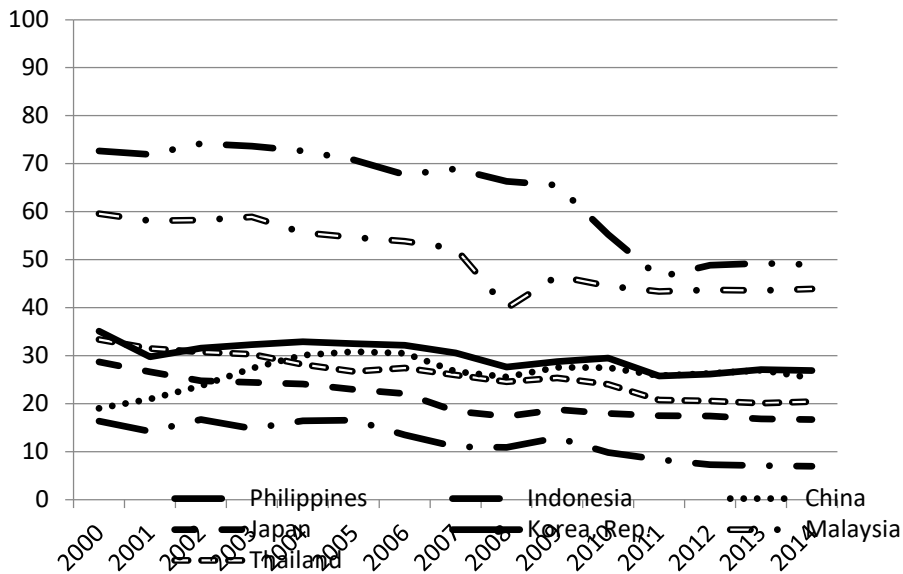
Increasing exports is commonly considered to be a major determinant to the economy growth. This phenomenon is generally known as Export Led Growth. This can be seen from over the past 20 years, the growth of world trade has averaged 6 percent per year, twice as fast as world output (IMF report, 2009). As every country wants to have sustainable economic growth, they desperately striving to show that their products have better qualities than other countries. Specializes in some segments of the international provide better growth outcomes because of higher income elasticity or can be interpreted as a reflection of differences in the quality and intensity of technologies (Fagerberg, 1988; Dalum *et al.*, 1999).

Sandu (2014) describes the high-tech industry has proven its strength in times of crisis. It displayed the highest growth rate of this industry compared to medium-high tech or low-tech sectors, among the European Union countries (Jaegaers *et al.*, 2013). During 2005-2011, the average annual growth rate for the EU 27 was 3.3%, regardless of the sizeable differences between countries. The highest growth rate was reported by Austria and Germany (6.6%), followed by the Czech Republic (5.4%), Hungary (4.6%) and the Netherlands (3.6%). In Romania, despite being one of the lowest growth rates for high-tech industry (1.7%), its medium-high tech industry registered the highest annual growth rate of all EU 27 countries, that is 12.7% (Thalassinos and Pociovalisteanu, 2007; Pociovalisteanu *et al.*, 2010).

The growth in the numbers and values of high-tech export sectors in every country certainly has an influence for the economic growth of each country. The seven Asian countries have a high high-tech exports percentage of total manufactured exports as shown in Figure 1. Despite the decline in the percentage of high-tech exports, the trade values in these seven countries are relatively stable and are considerably increasing in China. Furthermore, high-tech industries require large investment funds which are closely related to Foreign Direct Investment (FDI). This hypothesis is tried to be confirmed by the relationship of these three variables.

From the perspective of export-led growth hypothesis, a strong export performance is a key factor driving economic growth. First, export growth increases total productivity factor through capital formation. Second, export growth promotes an increase in imports of capital goods through exchange rates (Suryanto, 2016). Third, competition with overseas industries creates efficient pricing and encourages allocation of resources to industries that export goods. With this working hypothesis, the role of exports in high-tech goods contributes substantially to economic progress.

**Figure 1.** High-Tech Exports (% of manufactured exports)



**Source:** World Development Indicators

Unlike the export-driven growth hypothesis, the causality of output growth on export growth can also occur. As economic growth occurs, some industries experience changes through technological innovations, human capital, and accumulation of FDI. As a result, there is an increase in output of goods produced by a number of companies. Regardless of policy of export improvement, excess supply to domestic demand will boost export growth.

Considering the effect of FDI on a nation's economy, FDI inflows provide additional capital that is available for the production process in host country for a certain period of time. In addition, FDI also improves human capital with technology and management (Dunning (1973), Hymer (1976)) which has a direct impact on GDP. However, Islam (1995) argues that human capital variables do not appear significantly in panel data regression because the ability to absorb information through FDI is important too. Therefore, the interaction of FDI and human capital factors together can be fully accounted for an increase in GDP. With this hypothesis, FDI has a positive contribution to the economic growth of the country.

There are a number of contributing factors to the success of economic growth that attracts FDI inflows. First, openness increases the number and value of international trade because this condition allows the transfer of factors of production easily and efficiently. Second, human capital urge the desire of investors to invest in that country. The availability of workers is not only represented by large quantities and

low cost, but high productivity, *ceteris paribus*. Lucas (1988) argued that human capital accumulation had an internal effect (affects on one's productivity) and external effects (contributes to the productivity of all production factors). Third, the large amount of domestic capital attracts foreign investors because FDI and domestic capital are complementary in the production process (Clegg & Scott-Green, 1999; Naude & Krugell, 2007; Obwona, 2001). On the other hand, FDI may displace domestic savings (Cohen, 1993; Papanek, 1973; Reinhart & Talvi, 1998). Fourth, currency depreciation and the interest rate of domestic countries provide incentives for foreign investors because foreign firms have the opportunity to export more to gain more returns (Suryanto, Hadi and Hussain, 2016; Thalassinos and Politis, 2012; Thalassinos *et al.*, 2012).

The motive to specialize product can enhance trades between countries because producing particular products is not only having comparative advantage to final goods, but also participating in production ties with other final goods. Urata (2008) described that the formation of regional production and distribution networks in East Asia caused an increasing dependence of each country on trade with other East Asian countries, thereby enhancing regional economic integration. The dependency rates in East Asian trade have increased. When the region was defined as 10 ASEAN members together with China, Hong Kong, Japan, South Korea and Taiwan, interdependence increased from 43% in 1990 to 53% in 2006. Over the same period, interdependence rose only from 38% to 44% in the North American Free Trade Agreement (NAFTA) area, while it fell slightly from less than 67% to 66% in 25 EU members. As a result, economic integration has developed quite rapidly in East Asia.

Also, fragmentation and specialization of goods bring good opportunities for developing countries to raise exports and FDI. According to the WTO (2011), FDI flowing into Asia continued to increase, since the mid-1980s with a value of US \$ 5 billion per year, in 1990 reached US \$ 23 billion, and in 2008 reached US \$ 307 billion. At the same time, exports of intermediate goods by Asian countries rose from 26 percent in 1995 to 35 percent in 2009.

According to UNCTAD, the developments of investment were accompanied by a shift from syndicated bank lending to FDI as a major source of external financing for developing countries (Ekananda, 2017). In 1980-1985 bank loans and credit providers accounted for 69% of all private capital flowing into developing and Eastern European countries, while this share fell to 11% in 1998-2002. Over the same period, the share of FDI rocketed from 30% to 82%, and the equity investment portfolio risen from less than 0.1% to over 6%.

Viewed from its development, FDI inflows in Indonesia have been abundant since the late 1980s until the Asian economic crisis in 1997-1998. However, the 2008 US economic crisis caused FDI flows in the short term to decline due to the high cash outflow to developed countries caused by the debt repayment obligations. After the crisis, there was an increase in the flow of FDI to Indonesia. Over the last five years,

the net inflows of FDI to Indonesia from foreign investors have an accelerating trend. However, Indonesia's exports in high-tech sectors declined.

Furthermore, FDI brings about the accumulation of capital, knowledge, high-tech production, marketing skills, R&D and innovation that strengthen the nation's technological infrastructure. For example, Intel built a microprocessor facility that was not available in Ireland. It has built up the technology sector there since 1989. Another thing can be observed in Malaysia that has succeeded in attracting large amounts of FDI by providing significant profits for foreign companies wishing to invest in high-tech industries and capital-intensive industries. After foreign investors have left Malaysia due to cheap labor and attractive conditions provided by China, local entrepreneurs continue to invest in high-tech goods production activities, allowing the country to become one of the world's top exporting countries. In fact, they were able to increase the share of technology products in manufacturing exports by as much as 40% that helped economic growth (UNCTAD, 2015). Ultimately, MNC will boost the volume and value-added of high-tech products that enhance the competitiveness of domestic countries in foreign trade and will help to achieve sustainable economic growth of the country.

Given that FDI flows have increased significantly in recent decades, several studies have examined the impact of FDI on domestic economic performance. The impact of growth by FDI and exports is found to be different in each country due to the low human capital, geography, trade policies, and economic and social issues of each complex country. Despite that, many studies focus on the influence of FDI on GDP and the research around the impact of the existence of an export-focused industry (i.e. high-tech and non-tech goods / services to the domestic industry through the effects of externality and productivity) is still little discussed. The role of FDI, GDP, and high-tech exports in domestic countries have more value because technology and human development are long-term assets for economic growth.

## **2. Theoretical Framework**

This section would come out with the model proposed by Feder (1983) to study about effect from export to economic growth thoroughly. Total output on country's economy,  $Y(t)$ , consists of export,  $X(t)$ , and non-export,  $N(t)$ . Unlike Feder (1983), there are  $S$  different export sectors, so  $X(t) = \sum_{i=1}^S X_i(t)$ .

The production in non-export sector will be influenced directly by the volume of produced exports. In addition to production in non-export, there is asymmetric dependence, in terms of exports from different sectors, which can affect different non-exporting production. Consider a generic production function for the externalities effects of non-export sector from different export sectors,

$$N(t) = F(K_N(t), L_N(t), X_1(t), X_2(t), \dots, X_S(t))$$

where  $K_N(t)$  and  $L_N(t)$  are the capital and labor used in the non-export sector. Export production in sector  $i$  is expressed by

$$X_i(t) = G_i(K_i(t), L_i(t)) \quad i = 1, \dots, S$$

where  $K_i(t)$  and  $L_i(t)$  are the capital and labor used in the export production from sector  $i$ . Assumption, productivity differs between the non-export sector and each of the specific export sectors  $\delta_i > -1$ ,

$$\frac{\partial G_i / \partial K_i}{\partial F / \partial K_N} = \frac{\partial G_i / \partial L_i}{\partial F / \partial L_N} = 1 + \delta_i \quad i = 1, \dots, S$$

Another equation is

$$\frac{dN}{dt} = \frac{\partial F}{\partial K_N} \frac{dK_N}{dt} + \frac{\partial F}{\partial L_N} \frac{dL_N}{dt} + \sum_{i=1}^S \frac{\partial F}{\partial X_i} \frac{dX_i}{dt},$$

Since  $Y = N + \sum_{i=1}^S X_i$ , it could be manipulated

$$\frac{dY/dt}{Y} = \frac{\partial F}{\partial K_N} \frac{dK/dt}{Y} + \frac{\partial F}{\partial L_N} \frac{dL/dt}{Y} + \sum_{i=1}^S \left( \frac{\partial F}{\partial X_i} + \frac{\delta_i}{1 + \delta_i} \right) \frac{dX_i/dt}{X_i} \frac{X_i}{Y},$$

where  $K = K_N + \sum_{i=1}^S K_i$  and  $L = L_N + \sum_{i=1}^S L_i$ .

Feder (1983) used the assumption that there was a linear relationship between the marginal productivity of labor and the average output per worker,  $\partial F / \partial L_N = \gamma(Y/L)$ , then eq. 5 becomes

$$\frac{dY/dt}{Y} = \beta \frac{dK/dt}{Y} + \gamma \frac{dL/dt}{L} + \sum_{i=1}^S \left( \frac{\partial F}{\partial X_i} + \frac{\delta_i}{1 + \delta_i} \right) \frac{dX_i/dt}{X_i} \frac{X_i}{Y},$$

where  $\beta$  is the marginal productivity of capital in the non-export sector which is assumed to be constant.

As using eq.6, the effect of export from different sectors on economic growth can be determined empirically despite externality effect,  $(\partial F / \partial X_i)$ , and productivity differential effect,  $\delta_i / (1 + \delta_i)$ . Cuaresma and Wörz (2005) built specification which is more adequate for applied work if production function for the nonexport sector is parametrized

$$N = F(K_N, L_N, X_1, X_2, \dots, X_S) = \left( \prod_{i=1}^S X_i^{\psi_i} \right) \tilde{F}(K_N, L_N)$$

$$\frac{\partial F}{\partial X_i} = \psi_i \frac{N}{X_i}$$

Can be written as

$$\frac{dY/dt}{Y} = \beta \frac{dK/dt}{Y} + \gamma \frac{dL/dt}{L} + \sum_{i=1}^S \left[ \psi_i \frac{dX_i/dt}{X_i} \left( 1 - \frac{\sum_{i=1}^S X_i}{Y} \right) + \frac{\delta_i}{1 + \delta_i} \frac{dX_i/dt}{X_i} \frac{X_i}{Y} \right]$$

The equation will allow for estimates  $\psi_i$  dan  $\delta_i$  for  $i = 1, \dots, S$  to be obtained empirically.

Feder combined the entire export industries sectors in his research. For this research, the export industry is split into two sectors, non-high-tech sector and high-tech sector. The model will be used for export groups in technology content.

$$\frac{\delta_i}{1 + \delta_i} = \frac{G_k - F_k}{G_k} = \frac{G_l - F_l}{G_l}$$

Based on the equation above, productivity effect is defined as the ability to produce export goods compared to domestic goods with the same input. The export industry is expected to have competitive environmental factors. This causes the industry to continue to innovate and use resources more efficiently. When the productivity effect is positive, the export industry will produce more output than the domestic industry. Furthermore, a positive productivity effect reflects the allocation of resources to be maximized for the export industry. The same applies to negative productivity effects.

The effect of externalities,  $\psi_i$ , may reflect that the increase of output from certain sectors would have an impact on domestic industrial output. If the export industry of a certain sector has a positive externality effect, there is a growth of the share of domestic industry in GDP from year to year. Meanwhile, the export industry of a sector has a negative externality effect if there is decline in the share of domestic industry in GDP from year to year.

Recently, Oladipo (2013) examined the impact of FDI on growth in panels from 16 countries in Latin America and the Caribbean. Researchers found that FDI had an impact on economic growth in 13 out of the 16 countries. The study conducted by Ahmad and Harnhirun (1995) examined relationship of export to countries' growth in ASEAN, namely Indonesia, Malaysia, Philippines, Singapore, and Thailand, using data from 1966 to 1990. Based on the results of cointegration tests and Granger causality test, export certainly having an impact on growth was only found in Singapore. Recently, Tang et. Al. (2015) examined the hypothesis of export supporting growth in four small Asian dragons (Hong Kong, Singapore, South Korea, and Taiwan) using cointegration and Wald causality tests. Research showed that exports and GDP cointegrated for all four countries and implied a long-term relationship between variables. Research conducted by Cuaresma and Wörz (2005) by developing Feder equations (1983) found that high-tech goods exports had productivity impacts in some developing countries, while the same condition did not happen in OECD countries.

### **3. Analytical framework**

To know thoroughly the relationship of high-tech exports with economic growth, the model that used by Feder (1983) and Cuaresma and Wörz (2005) was modified on equation 6. In addition, investment in domestic countries will be divided into

domestic and foreign parties. Because this study aims to see the effect of FDI on GDP, the equation  $\Delta K_{it}/Y_{it}$  will be splitted into FDI and DDI. It can also be an additional piece of information to show empirically the effect of foreign and domestic direct investment for the country's output in general and specific industries in particular.

$$\frac{\Delta Y_{it}}{Y_{it}} = \alpha + \beta_1 \frac{\Delta DDI_{it}}{Y_{it}} + \beta_2 \frac{\Delta FDI_{it}}{Y_{it}} + \beta_3 \frac{\Delta L_{it}}{L_{it}} + \sum_{i=1}^S \left( \frac{\partial F}{\partial X_i} + \frac{\delta_i}{1 + \delta_i} \right) \frac{\frac{dX_i}{dt} X_i}{X_i Y} + \beta_4 y_{i,1992} + \varepsilon_{it}$$

The above equation will allow us to see overall impact of various export sectors on growth and be used in econometric models as

$$GDP_{it} \text{ Growth} = \alpha + \beta_1 DDI_{it} \text{ Growth} + \beta_2 FDI_{it} \text{ Growth} + \beta_3 Lab_{it} \text{ Growth} + \beta_4 Export \text{ non}_{it} + \beta_5 Export \text{ HTE}_{it} + \beta_6 \ln GDP_{i,1992} + \varepsilon_{it}$$

where  $\beta_4$  and  $\beta_5$  are the impact of non high-tech exports and high-tech exports respectively.

The contributions of particular export composition on GDP denoted by  $\beta_4$  and  $\beta_5$  in eq. 12 are attempted to be isolated through externalities and productivity. In the reference review, the value of the externality effect of a certain sector will use the formula ie

$$\sum_{i=1}^S \frac{dX_i/dt}{X_i} \left( 1 - \frac{\sum_{i=1}^S X_i}{Y} \right).$$

For this study, the value of the the externality effect which is more adequate for applied work is

$$\sum_{i=1}^S \frac{e^{f(x)}}{1 + e^{f(x)}}; f(x) = \frac{dX_i/dt}{X_i} \left( 1 - \frac{\sum_{i=1}^S X_i}{Y} \right).$$

Productivity differential effect will be determined by

$$\sum_{i=1}^S \frac{dX_i/dt}{X_i} \frac{X_i}{Y}$$

This equation will be model 2 ie

$$GDP_{it} \text{ Growth} = \alpha + \beta_1 DDI_{it} \text{ Growth} + \beta_2 FDI_{it} \text{ Growth} + \beta_3 Lab_{it} \text{ Growth} + \beta_4 Produc \text{ non}_{it} + \beta_5 Produc \text{ HTE}_{it} + \beta_6 Exter \text{ non}_{it} + \beta_7 Exter \text{ HTE}_{it} + \beta_8 \ln GDP_{i,1992} + \varepsilon_{it}$$



where  $\beta_4$  and  $\beta_5$  are the difference in non-high-tech and high-tech export productivity with the domestic sector.  $\beta_6$  and  $\beta_7$  are non-high-tech and high-tech exports respectively, from sector  $k$  to the domestic sector.

Productivity variables are changes in the amount of export output divided by GDP. This explains that industries in certain sectors are productive when there is positive changes in the value of export products each year in GDP. Negative annual export changes explains that the export industry of a sector in some countries are reluctant to give productivity impact on economic growth.

Meanwhile, the externality variable is the export growth multiplied by the non-export industry share in GDP. For example, the export growth of a sector every year is the same. When this year's externalities variables are smaller than last year, domestic industrial output is disrupted along with the sector's export growth. If this year's external variables are bigger than last year, the export growth of the sector helps the growth of domestic industrial output in the country.

Specific conditions will affect the country's economic growth. Therefore, this study will divide the scope into a non-high technology and high-tech intensive export country. This equation will be model 3 and model 4 ie

$$\begin{aligned}
 GDP_{at} Growth &= \alpha + \beta_1 DDI_{at} Growth + \beta_2 FDI_{at} Growth \\
 &\quad + \beta_3 Lab_{at} Growth \\
 &\quad + \beta_4 Produc non_{at} + \beta_5 Produc HTE_{at} + \beta_6 Exter non_{at} + \\
 &\quad \beta_7 Exter HTE_{at} + \beta_8 \ln GDP_{i,1992} + \varepsilon_{at} \\
 \\ 
 GDP_{bt} Growth &= \alpha + \beta_1 DDI_{bt} Growth + \beta_2 FDI_{bt} Growth \\
 &\quad + \beta_3 Lab_{bt} Growth \\
 &\quad + \beta_4 Produc non_{bt} + \beta_5 Produc HTE_{bt} + \beta_6 Exter non_{bt} + \\
 &\quad \beta_7 Exter HTE_{bt} + \beta_8 \ln GDP_{i,1992} + \varepsilon_{bt}
 \end{aligned}$$

where a on the scope of non high-tech intensive exports and b on the scope of high-tech intensive exports countries.

The data to be used in this study is panel data which is a combination of data consisting of 50 countries, namely Argentina, Australia, Austria, Barbados, Bolivia, Brazil, Canada, Chile, China, Colombia, Cyprus, Denmark, Ecuador, Finland, France, Germany, Hungary, Malta, Malta, Malta, Mauritius, Mexico, Netherlands, New Zealand, Norway, Oman, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Singapore, South Africa, Spain, Sweden, Switzerland, Thailand, Tunisia,

Turkey, United Kingdom, and the United States. Data from 1992 to 2014 used are obtained from World Bank Indicators.

**Table 1.** Descriptions, data sources, and descriptive statistics of variables

Variable	Definition	Sources
Period-average annual growth of GDP (GDP Growth)	$\Delta \text{ GDP (real US\$)} / \text{GDP (real US\$)}$	WDI
Period-average share domestic investment of GDP (DDI Growth)	$\Delta (\text{gross fixed capital formation (GFCF) (real US\$) - foreign direct investment net inflows (FDI) (BoP, real US\$)}) / \text{GDP (real US\$)}$	WDI
Period-average share foreign investment of GDP (FDI Growth)	$\Delta (\text{foreign direct investment net inflows (FDI) (BoP, real US\$)}) / \text{GDP (real US\$)}$	WDI
Period-average labor Growth (Lab Growth)	$\Delta \text{ Labor force (total)} / \text{Labor force (total)}$	WDI
Export Non	$\Delta (\text{exports of goods and services (real US\$) - high-tech exports (real US\$)}) / \text{GDP (real US\$)}$	WDI
Export HTE	$\Delta (\text{high-tech exports (real US\$)}) / \text{GDP (real US\$)}$	WDI
Produc Non	$\Delta (\text{exports of goods and services (real US\$) - high-tech exports (real US\$)}) / \text{GDP (real US\$)}$	WDI
Produc HTE	$\Delta (\text{high-tech exports (real US\$)}) / \text{GDP (real US\$)}$	WDI
Exter Non	$\Delta (\text{exports of goods and services (real US\$) - high-tech exports (real US\$)}) / \text{exports of goods and services (real US\$)}$ $*(1 - (\text{exports of goods and services (real US\$)} / \text{GDP (real US\$)}))$	WDI
Exter HTE	$\Delta (\text{high-tech exports (real US\$)}) / \text{exports of goods and services (real US\$)}$ $*(1 - (\text{exports of goods and services (real US\$)} / \text{GDP (real US\$)}))$	WDI

The processing method used in this research is panel data regression. The panel data itself is formed by a set of data consisting of 50 countries from 1992 to 2014 with some independent variables that have been processed before. Panel data to be used is pooled. To estimate panel, the model to be used is random effect model. Ekananda (2016) note that Feasible Generalized Least Square (FGLS) the suitable method for this research.

#### 4. Results

In this section we will derive the measures that have been taken and the results that have been produced in empirical model. The process is estimating the economic growth model of a country using fixed effects regression. The result will be interpreted with slope coefficient and significance in defining the dependent variable. Furthermore, the analysis part will compare the estimated result with the relation between variables from the former research. The analysis will expound the relevant data and information for comparing the estimated result with the real condition.

**Table 2.** *Feder Estimates Adjusted using Model 1*

Variable	Coef.	Std. Err.	z	P > z	[95% Conf.	Interval]
Constant	-0.001	0.012	-0.120	0.907	-0.025	0.022
DDI	2.538	0.052	48.710	0.000	2.436	2.640
FDI	2.525	0.053	48.070	0.000	2.422	2.628
Labor	-0.191	0.083	-2.290	0.022	-0.354	-0.027
export_non	0.482	0.033	14.670	0.000	0.418	0.547
export_hte	-0.128	0.102	-1.260	0.209	-0.329	0.072
init_gdp	0.000	0.001	0.630	0.528	-0.001	0.001

From model-1, the ratio of the difference between annual FDI / DDI and total output each year indicates the influence of capital on the growth of the country. Coefficient symbol and signifikansi variable DDI, as well as FDI variable, shows positive impact on economic growth. The changes in values of domestic investment is in favored position since it has greater impact in GDP changes than the changes in values of FDI. The conclusion is the impact of capital on economic growth is in line with predictions on theoretical models by increasing physical capital in the domestic economy directly, Plosser (1992) or indirectly building technology, Levine and Renelt (1992).

Infrastructure projects such as electricity, roads, airports, irrigation and drinking needs systems, and telecommunication are basis for modern economy. These elements have big multiplier effects because as presented by Federal Reserve Bank of San Fransisco, \$1 spent for infrastructure give better result than \$2. For example, when the power plant is successfully built, countries not only create employment directly through the construction and operations at power plants, but also help industries that need large power plants.

The influence of labor on country growth is indicated by the ratio of labor and economy growth every year. From model-1, the variable coefficient shows a negative result which is indicating a significant role. The conclusion of the labor impact on economic growth is different from the predictions on the theoretical model by increasing the number of labor and capital, and thus there may be output growth (Solow, 1956).

This labor variable alone could be interpreted as the output produced by countries in every labor increase. However, this variable will badly affect the growth shown in model-1. One of the possible reasons for this condition is that the age dependency ratio is greater than the non-working population. As a result, the working population will work and indirectly bear the age dependency ratio. This case is possible, the workers do not have more incentive to develop their ability to increase productivity, and is pointed out by Solow (1956) with the effectiveness of labor or knowledge by multiplying the labor variables.

Wages are commonly considered as a very important factor for the competitiveness of companies, especially in the global market. Wakelin (1998) showed wages from 2 perspectives. First, firms have labor costs that can be measured by the percentage of total wage costs of income. If wage costs is bigger than income, then there would be negative effect on export of companies, especially the ones which compete in a cost-intensive market. Second, companies use a certain average salaries. Labors with wages exceed the average wage are considered as indicator of a large amount of human capital accumulated in the firm. In this case, higher wages are expected to bring more competitiveness and significance in export.

Another possibility in the labor variable not affecting the country's economy growth is the substitution of the production process with labor intensive to smart machines. For example, Foxconn, the world's largest manufacturing company, employed more than 1 million workers in China. In 2011, this company used 10.000 robots known as Foxbots. A batch of 30.000 robots, which costed \$20.000 for each robot, was added every year. These robots did work routine such as spraying, welding, and assembling. On 26 June 2013, Terry Gou, CEO of Foxconn, said, "We have more than 1 million workers. In the future we will add 1 million industrial robots in order to avoid hiring the next million people."

By using Moore's Law, which is the IC complexity will be doubled every two years, the costs per 2 units of Foxbots is not likely to become cheaper. This development will be the biggest challenge faced by the free market in this century because the economic actors have no economic value.

Model-1 also involves the export of high-tech goods and the export of non-high-tech goods variables. From this goods segmentation, high-tech goods gave no influence upon the studied countries. On the other hand, the non-high-tech goods precisely help countries grow significantly.

The fraction between the rise of non-high-tech exports and economic output draw a bigger percentage when it comes to the processed data from each country. This seems ambiguous considering high-tech goods are expected to bring the country's growth through international trade in competitive goods and services. Feder (1983) stated that international trade in technology-intensive industries had high productivity and positive externalities compared to less complex or low technology activities.

**Table 3.** *Feder Estimates Adjusted using Model 2*

Variable	Coef.	Std. Err.	z	P > z	[95% Conf.	Interval]
Constant	0.025	0.013	2.030	0.042	0.001	0.050
DDI	2.245	0.055	40.730	0.000	2.137	2.353
FDI	2.232	0.056	40.180	0.000	2.123	2.340
Labor	-0.151	0.080	-1.890	0.059	-0.308	0.006
produc_non	-0.201	0.059	-3.420	0.001	-0.316	-0.085
produc_hte	0.080	0.083	0.970	0.334	-0.083	0.244
exter_non	0.584	0.044	13.410	0.000	0.498	0.669
exter_hte	-0.001	0.004	-0.280	0.780	-0.008	0.006
init_gdp	-0.001	0.001	-1.960	0.049	-0.002	0.000

Continue with research on Model-2, the role of DDI and FDI variables remains consistent. This condition proves theoretical and empirical research that investment is one of the most powerful determinants of long-term economic growth. Labor variable remains stagnant in its role in the long-term economic growth as in Model-1. To maintain the output of a country, the amount of the population is still needed at a certain level. However, this case provides an understanding of the changing role of human beings into machines and technology in driving economic growth.

As described in section 2, the impact of exports on the country's economy is expected to pass through the effects of externalities and productivity. The result of regression equation of model 2 shows that not every international trade has an impact through externalities and productivity. In

Table 3, the non-high-tech export productivity coefficient is lower than the domestic sector one and negatively affects the country's economic growth. High-tech export productivity coefficient is also higher than in the domestic sector one but this variable does not help significantly for the country's economy. On the other hand, there is a positive external effects of the non-hi-tech exports sector for the local industry to significantly increase domestic output. Yet, the coefficient of externality of high-tech exports is positive and does not help in the country's economic growth

The balance sheet, the accumulation of knowledge, productivity, and economic integration of each country have different levels. They make the process of production, distribution, and consumption of goods or services have different values as well. This is also conveyed by Alfaro *et al.* (2004) regarding the importance of financial markets for the success of economic growth, human resources, and technology. Model-2 explains the difference. FDI and DDI growth variables continue to show a positive impact for the country's economy consistently.

High-tech and non-high-tech exports are expected to have different impacts to economic growth depending on the composition of exports of each country. Based on the distribution of the value of high-tech export percentages in Table 4, countries are grouped according to high-tech export composition in

Table 5. The non-high-tech intensive exports countries in this study have an average value of high-tech export composition < Q2. Conversely, the high-tech intensive exports countries have an average value of high-tech export composition > Q3.

**Table 4.** *Average Ratio of High-Tech Export to Total Exports per Country*

Variable	Mean	Minimum	Maximum	Q1	Q2	Q3
Percentage of high-tech exports	8.457	0.217	38.249	1.850	4.409	12.84

**Table 5.** *Group of Countries based on the High-Tech Export Quartiles*

Kelompok	Negara
< Q1	New Zealand, Colombia, Barbados, Turkey, Mauritius, Chile, Oman, Peru, Ecuador, Madagascar, Cyprus, Paraguay
Q1-Q2	Brazil, Spain, Portugal, India, Romania, Bolivia, Norway, Poland, Australia, Iceland, South Africa, Tunisia, Argentina
Q2-Q3	United Kingdom, Mexico, Germany, Netherlands, Finland, Switzerland, Israel, Sweden, Austria, Denmark, Canada, Italy, Indonesia
>Q3	Philippines, Singapore, Malaysia, Korea, Ireland, Japan, China, Malta, Thailand, Hungary, USA, France

**Table 6.** *Feder Estimates Adjusted using Model 3 (Non-high-tech Intensive Exports Countries)*

Variable	Coef.	Std. Err.	z	P > z	[95% Conf.	Interval]
Constant	0.045	0.015	3.020	0.003	0.016	0.074
DDI	1.860	0.073	25.520	0.000	1.717	2.003
FDI	1.854	0.075	24.720	0.000	1.707	2.001
Labor	-0.109	0.100	-1.090	0.277	-0.306	0.088
produc_non	-0.682	0.137	-4.980	0.000	-0.951	-0.414
produc_hte	2.478	0.831	2.980	0.003	0.849	4.107
exter_non	1.015	0.079	12.790	0.000	0.859	1.170
exter_hte	-0.008	0.005	-1.640	0.102	-0.017	0.001
init_gdp	-0.002	0.001	-3.210	0.001	-0.004	-0.001

As seen from

Table 6 for model-3, economic growth from exports perspective can be felt through the externality effects of non-high-tech sector while productivity effects in the non-high-tech sector are hampering the growth of the country. The productivity effects that hamper economic output are predicted due to the migration of resources from non-high-tech exports industries to domestic industries. This is because non-tech

goods are quite related to the inelastic demand. The positive externalities reflect the growth of non-high-tech export industries affecting domestic industries to expand in economic output. In case of non-high-tech sector, the negative effects of productivity can still be covered by the greater externalities effects.

High-tech sectors also provide productivity effects on economic growth. This shows the export growth of this sector to GDP. If it is linked to domestic industrial productivity, high-tech export industry productivity is also greater in countries that export tech goods intensively. This allows the countries to boost the output of high-tech export industries by diverting resources from domestic industries.

**Table 7.** *Feder Estimates Adjusted using Model 4 (High-tech Intensive Exports Countries)*

Variable	Coef.	Std. Err.	z	P > z	[95% Conf.	Interval]
Constant	0.005	0.023	0.230	0.820	-0.040	0.050
DDI	1.619	0.080	20.130	0.000	1.461	1.777
FDI	1.615	0.080	20.180	0.000	1.458	1.772
Labor	-0.035	0.175	-0.200	0.844	-0.378	0.309
produc_non	0.210	0.059	3.570	0.000	0.095	0.325
produc_hte	0.142	0.083	1.720	0.085	-0.020	0.304
exter_non	0.105	0.051	2.070	0.039	0.005	0.205
exter_hte	-0.028	0.021	-1.330	0.182	-0.068	0.013
init_gdp	0.000	0.001	0.360	0.717	-0.001	0.002

As seen from **Σφάλμα! Το αρχείο προέλευσης της αναφοράς δεν βρέθηκε.** for model-4, the economic growth from the non-high-tech exports perspective might be acknowledged through the externalities effects and productivity effects. The effect of export industry productivity of this sector is better than the industry for the domestic sector. This matter takes place due to the specific factors such as efficiency, innovation, etc. Positive externalities effect reflects that the growth of non-high-tech exports industries influence the domestic industries to advance in economic output in countries export compositions dominated by high-tech goods.

High-tech sectors also provide productivity effects on economic growth. This shows the export growth of this sector to GDP. If it is linked to domestic industrial productivity, high-tech export industry productivity is also greater in countries that export tech goods intensively. This allows the countries to boost the output of high-tech export industries by diverting resources from domestic industries.

When comparing the effects of productivity and externalities of the two groups of countries, the likelihood of these effects are greater in countries with a relatively low high-tech export composition. The externality effects of non-high-tech exports and productivity effect of high-tech exports are enormously perceived in countries with low high-tech export compositions. By contrast, productivity effect of non-high-tech exports is positively felt in countries with high-tech export compositions. The reason

for the difference in productivity effects of non-high-tech exports was that established countries in exporting high-tech had more efficient industries than non-high-tech exports countries. Additionally, exports that rely on services were believed to be lower in productivity than domestic industries (Cuaresma and Wörz, 2005).

The results of this study are quite dissimilar compared to Cuaresma and Wörz (2005) study. In a previous study, investment growth variables helped GDP growth. Labor growth in that study with a sample of all countries also helped the country's economy significantly and this condition is different from the regression results of this study. Cuaresma and Wörz found that export sector only affected the economy through productivity across the sample. When samples were broken down into OECD and non-OECD countries, productivity variables remain influential in non-OECD countries. In contrast, this study shows the externalities affecting the country's economy. Grossman and Helpman explained that the international battle making firms compete through improved production and management efficiency. Knowledge and technologies, which were indirect impacts of international trade, were likely to be seen in imports rather than exports.

This research also reveals the absence of the external effects of high-tech exports to domestic industries. This could occur due to low investment absorption capacity of the recipient countries. Borensztein *et al.* (1998) examined the impact of FDI growth in 69 developing countries over the past two decades. They found that FDI had a positive effect on economic growth when there was sufficient human ability in the recipient country to absorb advanced technology. In addition, the productivity of the workers also affected the amount of exported goods and/or services. Ortega-Argilés *et al.* (2010) concluded that the low productivity of the high-tech sector in Europe compared to the United States could not be explained by the level of investment in lower research. This was the consequence of the inability to transform research investment into a productive advantage for the firm.

## 5. Conclusion

This study analyzed 50 countries to see the effect of FDI and high-tech exports on GDP. In the section 1, it can be found about the influence of capital, labor, and high-tech exports on a country's economic growth. It could also be seen that a number of high-tech industries are closely related to the investment in related country. Then, the empirical model in the section 2 includes GDP growth, foreign and domestic investment, exports divided into two sectors, and labor in 50 countries. Due to differences in the share of high-tech goods exports, some countries are divided into two: group of countries with large portion of high-tech exports of goods and group of countries with small portion of exports of high-tech goods.

This study identifies a positive role on foreign and domestic investment in the economic growth in 50 countries, while the same condition does not happen to labor growth. Labor growth has negatively affected economic growth in these 50 countries. In terms of exports, only the non-high-tech one has a positive impact on



GDP growth in all sample countries. High-tech exports has no significant impact on GDP growth because the ratio between the changes every year of high-tech export and GDP in every year is still very small. Different conditions occur when grouping countries based on high-tech export compositions. In countries with large or small portion of high-tech exports, positive changes in high-tech exports each year have a significant influence on total output in both groups of countries.

For both groups of countries, high-tech goods exports affect GDP through productivity. The significance of productivity is greatly felt in the country with a less portion of high-tech goods exports. It means the growth of high-tech goods exports draw more portion from year to year. Non-tech goods exports in both groups of countries have an impact through the effects of externalities. On the other hand, productivity effects have a negative influence on countries with a small share of high-tech goods exports and a positive influence on countries with a high share of high-tech goods exports. The externalities effect of non-high-tech industries is positive. This might imply additional output of non-high-tech products and services provides positive assistance for additional domestic industrial output

This study reveals 50 countries experiencing an economic slowdown in every labor growth. Therefore, human empowerment in quality is still needed in economic growth. Subsequent research could leverage the quality of labor involves in domestic and export industries in explaining economic growth.

The high-tech goods exports is closely related to the import of high-tech raw materials from other countries. Current modelling not related to import activities, while the GDP calculation uses import value as a deduction of the total output of a country. Conducting research by looking at the composition of imports in an industry will explain in more detail the growth of goods / technology. It is intended to interpret the role of a country as a producer or distributor in international trade. The last point is that the effects of externalities can be explored further by looking at the effect of the export industry on domestic industries with the same or different sectors.

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